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REVIEW

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Effect of Compression Garments in the Speed Performance among Track and Field and Swimming student-athletes in a Catholic University of the Philippines

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*John Paul C. Alcantara[1abcde], Jessiel Tanya L. Belaño[1bcde], Mae Andrea G. Bernal[1bcde], Ivana Dianne F. Caballero[1bcde], Bryan Joshua R. Casao[1bcde], Jose Martin L. De Leon[1bcde], Dustine Jorell T. De Vera[123ae], Jerome Angelitud Porto[12ae], Álvaro Fortunato[1ae], Analin E. Porto[1ae]

[1]*Institute of Physical Education and Athletics, University of Santo Tomas, Philippines.*
[2]*Faculty of Pharmacy, University of Santo Tomas, Philippines.*

A B S T R A C T

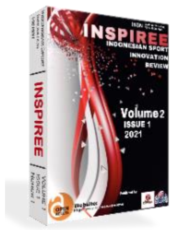
The purpose of the study. Speed is critical for sports such as swimming and track and field. One of the sports industry's solutions is compression garments to enhance athletic performance. This study aims to determine the effect of short and long compression garments on the speed performance of track and field and swimming athletes of the University of Santo Tomas.

Materials and methods. The researchers used quantitative and experimental methods. This study focused on the athletes of the track and field and swimming teams of the University of Santo Tomas. The researchers conducted the study at the open field, and swimming pool within the vicinity of the University, 14 athletes from track and field and 16 from the swimming team were invited to participate in the the 60M Sprint Test and Critical Swim Speed Test.

Results. The study shows a slight difference in the speed performance of track and field athletes when using short compression garments (7.54m/s) and long compression garments (7.44m/s). While swimming, the speed performance when using a long compression garment (1.450m/s) is higher than the short compression garment (1.512m/s). Both swimming (0.887) and track and field (0.559) show no significant difference in using the compression garment.

Conclusions. Based on the study, there is a minimal difference in using long compression garments against short compression garments. Therefore, the researchers recommend using long compression garments since this garment slightly increases participants' speed which is vital in any sport measuring speed to win a race. The researchers recommend further study by increasing the number of participants, only endurance athletes participants, and including the materials used in making the garments. This further helps the claim that long and short compression garments affect speed performance regardless of sports or events.

A R T I C L E I N F O



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*Corresponding Author John Paul C. Alcantara, e-mail: jpalcantara0414@gmail.com
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INTRODUCTION

Speed is the minimal time required for an object or person to move through a static distance without a specific direction. It involves moving the body as quickly as possible, but agility has the added dimension of changing direction (Harman and Garhammer, 2008). In other terms, speed refers to the ability to transfer the body as fast as possible at a distance. But, this issue is more complex because speed is inconsistent with the total length. Therefore, it can be divided into some phases: acceleration, maintenance of maximum speed, and deceleration (Plisk, 2008).

As mentioned above, there is a slight inconsistency in the speed component. In sports, speed and the rate of change is critical. One of the solutions that the sports industry provides is the use of compression garments. It developed a demand in the sector of sports today. The functions are to reduce muscle injuries, maintain muscle functions, and could even enhance athletic performance. These compression garments are popular among professional and amateur sports participants and are high-tech equipment used with a specific function (Fu, Liu, and Fang, 2013).

Today, accessible compression garments in commerce are proposed to deliver performance benefits to athletes. These are used during their competition and training to assist their performance. After exercise to speed recovery, it is recommended to improve peripheral circulation and venous return, reduce muscle oscillation and improve clearance markers of muscle damage (Duffield and Portus, 2007). Coaches frequently pursue acute strategies to enhance training performance to acquire elite sports' maximum competitive benefit. For example, post-activation and warm-up techniques are widely explored and have proven benefits to performance in endurance running, explosive throws and jumping, etc. (McGowan, Pyne, Thomson, and Rattray, 2015; Seitz and Haff, 2016).

Athletes' clothes have experimented with compression garments in various speed sports to improve performance for many years. (Moria, Alam, Chowdhury, and Subic, 2012). Cycling skin suits, swimming bodysuits, and graduated compression garments are three examples that demonstrate the function of materials and design (Vorontsov and Rumyantsev, 2000). The aerodynamic performance of flexible sports

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garments may be affected by the surface texture of the garment. Some manufacturers claimed a decrease in aerodynamic drag by using athletes' stretchable outfits, but no research data in the open literature supports these claims (Moria, Chowdhury, Alam, & Subic, 2011).

Compression garments are commonly made of several elastic textiles that exert compression (pressure) on human extremities and the trunk through their elasticity. The materials used in making the garments can be divided into two: a) Synthetic Fiber that contains polyurethane (most compression garments that are sports-related use this material), and b) Elastic fabric that consists of polyamide and elastodiene (mainly used to produce compression garments that are medical-related). Decent compression garments should be comfortable, absorb humidity, enhance skin contact, and ensure a proper fit and stretch. Also, they must be light and enduring (Fu et al., 2013).

Though there is research evidence in this body of research describing the character of compression garments in the vascular distribution in diseased patients, research evidence about athletic sports performance still lacks. Only a small body of research claims these garments may benefit sports performance or assist recovery from exercise (Duffield and Portus, 2007). Therefore, this study aims to support the claims that compression garments affect the speed performance of athletes in the event of Track and Field and Swimming. Also, the effect of long compression garments on the speed performance of the participants is compared.

This study investigates the effect of compression garments on the speed performance of selected student-athletes at the University of Santo Tomas. The study was based on the following constructs about aerodynamics and hydrodynamics.

According to Lucas (2014), aerodynamics studies how gases interact with moving bodies. The researchers' gas most encounters air; aerodynamics primarily concerns the forces of drag and lift caused by air passing over and around solid bodies. The most significant aerodynamic force that applies to nearly everything that moves through the air is drag which is the force that opposes an aircraft's motion. It is generated in the direction the air is moving when it encounters a solid object.

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In sports, aerodynamics is related to the flow of air around a projectile, which can influence the speed and direction of the object. Like a ball trajectory, the airflow around a ball thrown through the air differs greatly depending on whether it has a smooth or rough surface. In this study, the researchers determined the effect of compression garments on the speed performance of the athletes. In using compression garments, the researchers tested if the air resistance of the compression garment gave advantages or disadvantages to those using it.

On the other hand, Hydrodynamics is the study of liquids in motion. Specifically, it looks at how different forces affect the movement of liquids. A series of equations explain how mass, energy, and momentum conservation laws apply to liquids, particularly those not compressed (Myers, 2017).

Concerning sports, Fluid dynamics or hydrodynamics is the study of the forces, gases, and liquids created on a body that significantly impacts sports equipment and athletic performance. From the pattern design of dimples on a golf ball, the latest swimsuits, the curved flight path of tennis, cricket, or baseball, to the planning of a surfboard through water, fluid dynamics affects speed, motion, and ultimately athletic performance (Pallis and Mehta, 2004). Four primary forces act on a swimmer: thrust (propulsive forces), weight, drag, and buoyancy. The two other significant drag components are pressure drag and skin friction drag. Pressure drag results from water resistance over the swimmer's frontal area and the flow separation behind the swimmer. Therefore, a swimmer must streamline their body to reduce the amount of separation.

In this study, the researchers have considered the factors, which were water resistance and wave drag, that may have affected the speed performance of the swimmers in using compression garments. Water drag contributed as a factor that served primarily as the source of speed; the lesser the drag, the more the speed increases, and the more drag, the lesser speed obtained

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MATERIALS AND METHODS

Study participants

The researchers would not utilize a questionnaire in the study because the type of study conducted was an experimental one. Instead of using a questionnaire, the researchers conducted experiments involving the Swimming and Track and Field Athletes as their participants. The subjects of the study were chosen using a purposive sampling method. According to Calmorin (2010), the purposive sampling method is a non-scientific sampling based on selecting the individuals as samples according to purposes. The study subjects are the selected student-athlete of track and field and Swimming at the University of Santo Tomas. The inclusion of criteria considered the following as the basis in choosing the respondents: (a) must be a current member of a sports team in the University, (b) must be a member of the track and field and swimming team of the University, (c) must be student-athlete who belonged to the team A or B scholarship type in track and field and swimming, (d) must have an experience in using short and long compression garments.

Methods

The study aims to determine the effect of short and long compression garments on the speed performance among track and field and swimming student-athletes. In line with this, quantitative and experimental research was used by the researchers in the study. The quantitative method emphasizes the objective measurements and the statistical, mathematical, or numerical analysis of collected data through polls, questionnaires, and surveys or by manipulating pre-existing statistical data using computational techniques (Babbie and Mujis, 2010).

The researchers used true experimental research since the study used quantitative and testing methods. True experimental research is regarded as the most accurate form of experimental research. True experimental design is an essential part of science, frequently acting as a final test of a hypothesis. Whilst they can be artificial and restrictive, it is the only type of research recognized by all disciplines as statistically provable. (Shuttleworth, 2008).

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Testing procedure

In conducting the test, standard tests are used in every event/sport to measure different variables. One of the utilized tests in track and field, specifically in sprinting, is the 60M Sprint. According to Mackenzie (1999), the objective of the 60M sprint is to monitor the development of the sprint athlete's acceleration and pick up to the full flight.

The facilitators would set up the testing area by measuring 60 meters, with cone markers on the starting and finish lines. There would also be an additional 10 meters to ensure that the athletes would not decelerate as they approach the finish line. There would be one facilitator at the starting line and another two at the finish line. Before the test, a thorough warm-up should be given, including some practice starts and accelerations. The athletes would start standing with one foot in front of the other. The front foot must be before the starting line. The facilitator on the starting line would raise his other arm and drag it downwards as he shouts "GO" that’s also when the facilitator on the finish line starts the stopwatch. As the athlete hears "GO," he should sprint as fast as possible, over 60 meters. The facilitator on the finish line would stop the stopwatch when the athlete's torso crosses the finish line, then records the time. The test is conducted three times, and there would be 3 minutes of rest per trial.

While in swimming, the Critical Swim Speed Test is widely used. It is the theoretical swimming speed that can be maintained continuously without exhaustion. Coaches and swimmers can use this test to measure aerobic capacity and determine swimming training intensities. A CSS test was described by Wakayoshi et al. (1992) using swims over four distances (50, 100, 200, and 400m), and the CSS determines the slope of the regression line relating distance and time. This was later simplified to a two-swim test (50m and 400m) by Ginn (1993) and a simple formula to determine CSS.

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The test aims to calculate critical swim speed to measure endurance fitness and help set training swim intensities. The equipment required: a swimming pool (25m or 50m) and a stopwatch. Before the swimmer/participant starts, he is given 10 minutes to warm up. This test requires the athlete to swim 400m and, following a rest, 50m as fast as possible. Since the primary purpose of this study is to determine the speed, the researchers have modified the test. Instead of recording the swim time in the 400 meters, it would not be timed and would serve as the participant's warm-up in the water. At the same time, the swim over 50 meters would remain to be timed and would be repeated three times. The first to be conducted in the 400m. The athlete gets into the pool and starts with a push-off on the wall. The athlete could swim at his own pace as long as he covers 400 meters. After the 400meter swim, which served as his warm-up in the water, he would be given 10 minutes of rest. When the allotted time is over, the athlete will commence the 50meter swim at a maximal pace. There would be a facilitator on both ends of the pool, one on the starting line and the other at the finish. The facilitator on the starting line would raise his arm and drag it down as he blew the whistle, while the facilitator on the other end would start the time as he saw this action or signal. When the athlete hears the whistle, the participant will begin with a push-off on the wall, just like he did in the 400 meters. The facilitators at the finish line would stop the time when they saw the tapping of the hand of the swimmer on the wall. Since the swim over 50 meters would be repeated thrice, there would be a 5-minute interval between the swims.

RESULTS DISCUSSION

The main topics presented in this study are the demographic profile of the participants, the speed of the participants in using both compression garments, and the significant difference in the speed performance of the student-athletes.

1. Demographic Profile of Participants

TABLE 1. Demographic Profile on Age, Gender and Event. (n=30)

AGE	f	%	EVENT	f	%	GENDER	f	%
15	7	23.3	Track and Field	14	47	Male	22	73.3
16	8	26.7	Swimming	16	53	Female	8	26.7
17	9	30	**Total**	**30**		**Total**	**30**	**100**
18	6	20						
Total	**30**	**100**						

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Table 1 shows the demographic profile of the participants based on their Age, Gender, and Event. The majority of the participants from both events were aged 17 at 30%, 15 at 23%, age 16 at 26.7%, while 18 years of age got the least number of% out of all the participants, all from the senior high school of the University of Santo Tomas. The researchers brought 14 participants from Track and Field, which is 47% of the total. While swimming, the researchers gathered most of their data from this event with 16 participants, which is 53% of the total. Regarding gender, the study participants are primarily male, 22 out of thirty, 73.3%. While eight of the participants are female, that makes it 26.7% of the total participants in the study.

2. Speed of the participants in using Short and Long Compression Garments when grouped according to event.

Track and Field

TABLE 2. Average Speed of Track and Field Participants

P	SHORT COMPRESSION GARMENTS T1	T2	T3	Ave. Time (s)	SPEED (d/ At)	LONG COMPRESSION GARMENTS T1	T2	T3	Ave. Time (s)	SPEED (d/ At)	MD (m/s)
1	7.62	7.62	7.55	7.60	**7.89**	7.62	7.53	7.71	7.62	**7.87**	**0.02**
2	7.44	7.33	7.47	7.42	**8.09**	7.46	7.49	7.57	7.51	**7.99**	**0.10**
3	7.94	7.81	8.01	7.92	**7.58**	7.83	7.98	7.99	7.94	**7.56**	**0.02**
4	9.25	9.31	9.23	9.27	**6.48**	9.52	9.41	9.32	9.42	**6.37**	**0.11**
5	8.03	7.76	7.93	7.91	**7.59**	7.53	8.04	7.85	7.81	**7.68**	**-0.09**
6	7.77	7.78	7.7	7.75	**7.74**	7.86	7.56	7.78	7.74	**7.75**	**-0.01**
7	8.84	8.85	8.85	8.85	**6.78**	8.54	8.59	8.81	8.65	**6.94**	**-0.16**
8	7.90	7.88	9.13	8.30	**7.23**	7.99	7.95	7.95	7.96	**7.54**	**-0.31**
9	7.41	8.22	8.08	7.91	**7.59**	7.69	8.07	8.10	7.95	**7.55**	**0.04**
10	7.89	8.22	8.05	8.06	**7.44**	8.03	7.97	8.1	8.03	**7.47**	**-0.03**
11	8.11	7.56	7.25	7.64	**7.85**	7.55	7.51	7.35	7.47	**8.03**	**-0.18**
12	7.41	7.33	7.03	7.26	**8.26**	7.49	7.12	7.49	7.37	**8.14**	**0.12**
13	8.23	7.80	7.86	7.97	**7.53**	7.68	7.78	7.47	7.64	**7.85**	**-0.32**
14	9.03	9.32	9.14	9.17	**6.54**	8.79	8.77	8.74	8.77	**6.84**	**-0.3**

Legend: "-"(negative sign) indicates an increase in speed. MD – Mean difference in Speed (Speed in SCG – Speed in LCG)

As shown in ***Table 2***, the Average Speed of each participant in using both Short and Long compression garments of Track and Field was computed based on the three-recorded time/trials of every participant. As shown in Table 2, two (2) participants, namely participant 2 (8.09 m/s) and participant 12 (8.26 m/s), got the highest speed using short compression garments. For long compression garments, participant 11, with 8.03 m/s, and participant 12, with 8.14 m/s, got the highest rate. In terms of mean difference, participant 13, with -0.32 m/s, got the highest increase from using a short compression garment to a long compression garment.

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In analyzing the result in ***Table 2*** of the trials in Track and field athletes at the University, the researchers found that out of the 14 track and field participants, eight (8), or 57.14% of them, have performed better in terms of speed by using Long Compression Garments. In contrast, the other 42.86% performed better in using short compression garments. Based on the study of Diego Marqués-Jiménez, et al. (2016), the increasing population of compression clothing in different sports is likely due to their success in enhancing performance and recovery. As a result of additional findings, manufacturers of these garments have reported that compression garments improve recovery, increase power and enhance athletic performance.

Swimming

TABLE 3. Average Speed of Swimming Participants

P	SHORT COMPRESSION GARMENTS					LONG COMPRESSION GARMENTS					MD (m/s)
	T1	T2	T3	Ave. Time (s)	SPEED (d/ At)	T1	T2	T3	Ave. Time (s)	SPEED (d/ At)	
1	36.33	37.60	38.69	37.54	**1.33**	36.50	36.90	33.56	35.65	**1.40**	**-0.07**
2	35.71	36.49	36.18	36.13	**1.38**	34.11	34.49	34.76	34.45	**1.45**	**-0.07**
3	30.87	29.86	32.93	31.22	**1.60**	32.17	30.83	32.04	31.68	**1.59**	**0.01**
4	28.81	29.62	33.11	30.51	**1.64**	28.50	29.24	29.25	29.00	**1.73**	**-0.09**
5	28.47	28.99	29.03	28.83	**1.73**	27.94	28.00	27.01	27.65	**1.81**	**-0.08**
6	34.96	35.8	40.64	37.13	**1.35**	36.86	34.09	33.24	34.73	**1.43**	**-0.08**
7	37.17	39.44	37.15	37.92	**1.32**	35.83	36.19	33.82	35.28	**1.42**	**-0.1**
8	38.71	40.39	38.59	39.23	**1.27**	39.51	36.78	37.03	37.77	**1.32**	**-0.05**
9	38.4	40.4	37.25	38.68	**1.29**	39.52	36.91	36.6	37.68	**1.33**	**-0.04**
10	36.11	30.57	30.6	32.43	**1.54**	31.08	30.04	29.82	30.31	**1.65**	**-0.11**
11	33.22	33.98	37.35	34.85	**1.43**	33.31	33.77	33.56	33.55	**1.49**	**-0.06**
12	33.78	34.41	34.84	34.34	**1.45**	32.47	33.31	32.41	32.73	**1.53**	**-0.08**
13	31.45	29.98	29.27	30.23	**1.65**	29	28.93	29.14	29.02	**1.72**	**-0.07**
14	37.21	34.6	33.87	35.23	**1.42**	35.23	33.49	32.25	33.66	**1.49**	**-0.07**
15	38.33	37.02	36.9	37.42	**1.34**	35.15	36.06	36.09	35.77	**1.40**	**-0.06**
16	33.31	34.2	34.58	34.03	**1.47**	34.61	35.47	34.12	34.73	**1.44**	**0.03**

Legend: "-"(negative sign) indicates an increase in speed. MD – Mean difference in Speed (Speed in SCG – Speed in LCG)

As shown in ***Table 3***, the researchers observed a slight increase in the result of the three trials of the participants while using the long compression garment. In terms of the mean difference based on ***Table 3***, 87.5% of the swimming participants got an increase in their speed using Long Compression Garments. The participant with the highest result of mean difference is participant 10, with a result of -0.11m/s. This result means they perform better using longs rather than short compression garments. The formula used by the researchers to solve for the average speed was distance (d) divided by the average time (At). The average time of a participant is the sum of all the trials divided by the number of trials.

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Based on the result of swimming athletes of the University of Santo Tomas, the researchers discovered that there is more advantage in speed performance in using the long compression garment than the short compression garment. According to Fang et al. (2013), compression garments, as just one type of high-tech equipment using unique techniques and having specific functions, are also becoming increasingly popular among professional and amateur sports participants. The new compression swimming suit called "fast-skin," which made a big echo in the 2008 Beijing Olympic Games, compression garments are attracting increasing attention from researchers for its effects on maintaining muscle functions, reducing sports injuries, and enhancing sports performance. According to Morrison (2012), in a study done with French elite swimmers, the researchers found that a "Fast skin suit" creates conditions of lower resistance in the water, with the swimmers experiencing longer glide phases and better efficiency in the water. In other words, swimmers could swim faster and easier. Swim jammers help to reduce the drag in the water by removing seams through multiple stitching, heat bonding, welding, and designing the seams to direct the flow of the water. The suits become closer to being a second layer of skin, which helps the swimmers swim faster. The increase in the average speed may be since wearing a swimsuit could positively influence the swimmer's hydrodynamics, significantly reducing the pressure drag component. (Marinho, et al., 2012)

3. Significant difference in the speed performance in using short and long compression garments.

Track and Field

TABLE 4. Track and Field Event - Speed Performance

Compression Garment	Mean (Speed)	F	P-value	Decision	Remarks
Short Long	7.44 7.54	0.350	0.559	Accept Ho	NO SIGNIFICANT DIFFERENCE

α= 0.05

Table 4 shows that the mean of short and long compression garments in track and field are 7.44 and 7.54, respectively. The researchers used a T-test for independent variables and an alpha of 0.05 in the statistical analysis, which resulted in a computed P-value of 0.559. ***Table 4*** shows that the long compression garment mean is high and shows an advantage in obtaining more speed while using it.

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The absence of positive effects on maximal sprinting speed performance is not a novelty in compressive clothing. (Loturco, Winckler, et al., 2016) In agreement with our results, Faulkner et al. (2013) reported that compression garments could not improve the overall 400-m sprint performance or individual 100-m split times in elite sprinters. On the other hand, the authors demonstrated that these clothes might lower the effort perception associated with long-sprint performance (i.e., 400-m). Although the researchers performed our speed tests over shorter distances (20- and 70-m), the researchers also could not detect any important variation in the actual sprint times of the Paralympic athletes under either experimental conditions (i.e., compression or placebo).

Swimming

TABLE 5. Swimming Event - Speed Performance

Compression Garment	Mean (Speed)	F	*P*-value	Decision	Remarks
Short **Long**	1.450 1.512	0.025	0.887	Accept Ho	NO SIGNIFICANT DIFFERENCE

α= 0.05

Table 5 shows the results of using short and long compression garments in the speed performance of Swimming athletes. The researchers used the T-test for independent variables with an alpha level of 0.05, which resulted in a computed p-value of 0.887. Although the outcome shows no significant difference, the calculated means of speed somehow indicates that there is. According to ***Table 5,*** the computed means are 1.450 and 1.512 for short-compression garments and long-compression garments, respectively. Thus, the long compression garment has an advantage over the short compression garment.

Montagna et al. (2009), Hydrodynamic resistance, also known as drag, is a significant performance issue in swimming. Marinho et al. (2012) aforesaid that to achieve higher velocities, the swimmer should reduce the hydrodynamic drag force resisting forward motion and increase the propelling force. That is why several studies have analyzed the effect of wearing different equipment on hydrodynamic drag, with particular attention to the use of swimsuits (Toussaint et al. 2002; Mollendorf et al.

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2004; Pendergast et al. 2006). According to Doan et al. (2003), even if compression garments are not significantly responsible for maximizing the top results of athletes, they seem to have a significant effect on the endurance of the performance on repetitive movements and in longer distances, as in athletics and swimming.

CONCLUSION

It was possible to conclude that the chronometer method for high yield purposes is not recommended to use by an untrained subject, it results from a high deviation error compared to the photocell method. Based on the results obtained, we can conclude that the method through the chronometer overestimates the evaluations of the photocells. However, the method through chronometer remains plausible its use outside the context of high yield, due to its low cost, where in this medium is necessary a high reliability rate of results. The method through photocells has a much higher degree of reliability, but with high economic cost, being thus recommended for the context of scientific and sports production, aiming at high performance.

CONFLICT OF INTEREST

There is no conflict of interest among the participants, researchers, and study institution..

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APPENDIX

Information About The Authors:

John Paul C. Alcantara
Email: jpalcantara0414@gmail.com ; Institute of Physical Education and Athletics, University of Santo Tomas, España Boulevard, Sampaloc, Manila, Philippines, 1008

Jessiel Tanya L. Belaño
Email: jtanyabano@gmail.com ; Institute of Physical Education and Athletics, University of Santo Tomas, España Boulevard, Sampaloc, Manila, Philippines, 1008

Mae Andrea G. Bernal
Email: maeandreabernal17@gmail.com ; Institute of Physical Education and Athletics, University of Santo Tomas, España Boulevard, Sampaloc, Manila, Philippines, 1008

Ivana Dianne F. Caballero
Email: ivanadianne.caballero@gmail.com ; Institute of Physical Education and Athletics, University of Santo Tomas, España Boulevard, Sampaloc, Manila, Philippines, 1008

Bryan Joshua R. Casao
Email: casaobryanjoshua@yahoo.com ; Institute of Physical Education and Athletics, University of Santo Tomas, España Boulevard, Sampaloc, Manila, Philippines, 1008

Jose Martin L. De Leon
Email: martindeleon.96@gmail.com ; Institute of Physical Education and Athletics, University of Santo Tomas, España Boulevard, Sampaloc, Manila, Philippines, 1008

Dustine Jorell T. De Vera
Email: jorelldashtine43@gmail.com ; Institute of Physical Education and Athletics, University of Santo Tomas, España Boulevard, Sampaloc, Manila, Philippines, 1008

Assoc. Prof. Dr. Jerome A. Porto, LPT, M.A.Ed
Email: japorto@ust.edu.ph; https://orcid.org/0000-0002-4997-2949 Institute of Physical Education and Athletics, University of Santo Tomas, España Boulevard, Sampaloc, Manila, Philippines, 1008

Prof. Dr. Analin E. Porto, LPT, RMT, MA
Email: aeporto@ust.edu.ph ; https://orcid.org/0000-0002-6547-4675 Faculty of Pharmacy, University of Santo Tomas, España Boulevard, Sampaloc, Manila, Philippines, 1008

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